

Interfacing the ADS1241 to MSP430 Processors

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ABSTRACT

This application note presents a method for interfacing the modular ADS1241MEVM—an evaluation module (EVM) for the ADS1241 24-bit analog-to-digital converter—to the MSP430 series microcontrollers. The hardware used for this example includes the HPA449 from SoftBaugh, Inc. (www.softbaugh.com), featuring the MSP430F449. To reduce development time, the source code for this application note can be found on the Texas Instruments web site at www.ti.com. Search for document number [SBAA121](#) from the home page, and follow the links to this application note.

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1 Introduction

The modular ADS1241MEVM was designed to allow easy evaluation of the ADS1241 24-bit analog-to-digital (A/D) converter. This family of converters is able to gluelessly interface to the serial peripheral interface (SPI port) of most MSP430 series microcontrollers. For the development of this application note, the HPA449 Evaluation System along with the modular ADS1241M evaluation module and the MSP430 port of the open-source GCC compiler ([msp gcc](#)) were used.

2 Hardware

The combination of the HPA449 and the modular format of the ADS1241MEVM board is a convenient way of experimenting with the MSP430 series microcontroller and the ADS1241. The ADS1241MEVM plugs onto the HPA449 Evaluation System that provides a custom LCD screen to display the conversion results.

2.1 MSP430F449

While written specifically for the MSP430F449, the methods used in this application report can be adapted to most MSP430 family devices which contain at least one SPI port. Because the MSP430F449 device contains two SPI ports, it is possible to combine two ADS1241MEVM evaluation boards onto the HPA449 Evaluation System in order to realize simultaneous sampling applications using an SPI master/slave relationship.

3 ADS1241MEVM

The modular ADS1241MEVM provides a platform to demonstrate the functionality of this 24-bit A/D converter. The EVM interfaces with various Texas Instruments DSPs and microcontrollers, while allowing easy access to all analog and digital signals for customized end-user applications. For more information on this EVM, search for document number [SBAU106](#) from the main page of the Texas Instruments web site at www.ti.com.

3.1 Hardware Interface

The hardware interface between the HPA449 and the ADS1241MEVM is seamless. The HPA449 Evaluation System provides buffered access to the STE, SCLK, SIMO, and SOMI pins of ports 3 and 4 on the MSP430F449. The buffers are provided for protection of the MSP430 device and would not be required in an embedded system.

The hardware connections via the HPA449 Evaluation System are shown in [Figure 1](#). The SCLK, \overline{CS} , DIN and DOUT pins from the data converter are connected to SCLK, GPIO, SIMO and SOMI pins of port 3. The \overline{DRDY} pin is connected to TB1 on port 2.

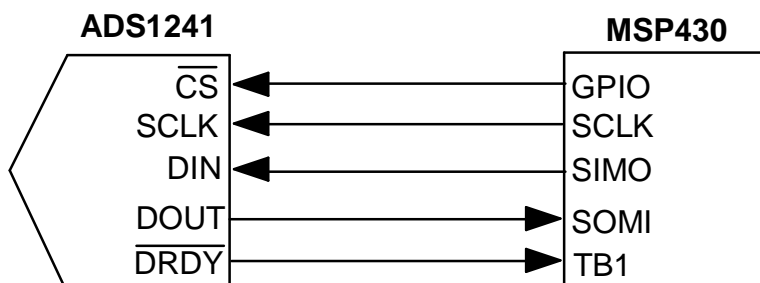


Figure 1. MSP430 Hardware Connections

4 Software Interface

The code archive associated with this application note (SBAA121.ZIP) contains the source files necessary to build this project. A Makefile is included as well that will build the hex (.a43) file needed to download into the HPA449.

All the software was written and compiled using mspgcc, the port of the open-source GCC compiler for the MSP430. The C-style programming examples provided in the code archive can be easily adapted for most any processor or software development environment.

4.1 Board Support Libraries

The archive for this software example contains all the necessary header files to enable the display function calls in the code.

4.2 SPI Port Settings

The serial port was set up using a 32kHz watch crystal found on the HPA449 (X1). The frequency lock loop (FLL) functions of the MSP430F449 then generate a 4.91MHz system clock for the processor. In the software provided for this example, the SPI port is set to a 3-wire master mode.

4.3 Software Flow

The software presented in this application report sets the ADS1241 up with a data rate of 15Hz and a PGA gain of 1. All eight channels of the ADS1241 may be examined, one at a time, by the user.

The program begins by initializing the HPA449 and the ADS1241. The HPA449 LCD display will show the version number of the firmware on the large display. The program then waits for the user to push SW2 on the HPA449 to proceed.

When SW2 is pressed, channel 0 will begin to be read. Data from the conversion is presented on the HPA449 LCD screen, and is also sent over the serial port on the HPA449. Using a terminal program, the data may be viewed on a personal computer. The serial port is configured to run at 115200 baud, 8-bit, no parity, with one stop bit.

Pressing SW2 again will select channel 1; subsequent presses will cycle through all eight channels. In each case, selecting a new channel will also cause the ADS1241 to perform a self-calibration.

The software associated with this application note expects the ADS1241MEVM to be loaded on the *SERIAL_A* portion of the HPA449 board. This corresponds to connectors J9, J12, and J7 for the analog input, power, and digital I/O, respectively.

4.4 Software Compile Options

The software presented here demonstrates some simple principles in interfacing the ADS1241 to the MSP430F449. The main setup of the ADS1241 is given by this code in main.c:

```
// Set the gain and multiplexer
ADS1240SetGain(ADS1240_GAIN_1);
ADS1240SetChannel(chan | ADS1240_MUXN_AINCOM);
// data rate = 15Hz (4.91MHz, SPEED = 1)
ACRVal = SPEED_BIT;
ADS1240WriteRegister(ADS1240_ACR_REGISTER, 1, &ACRVal);
// do an internal self cal
ADS1240AssertCS(1);
ADS1240SendByte(ADS1240_CMD_SELF CAL);
ADS1240AssertCS(0);
for (i=0; i<4; i++)
ADS1240WaitForDataReady(0);
```

Constants for gain settings (such as ADS1240_GAIN_1, as used above) are defined in the ads1240.h file, as well as constants for channel settings and device-specific commands. Note that after changing any of these settings on the ADS1241, a self-calibration should be performed as shown above.

For additional information on these and other Data Acquisition products from Texas Instruments, visit the TI web site at www.ti.com.

5 References

1. *MSP430x1xx Family Users Guide* ([SLAU049](#))
2. *ADS1241MEVM Users Guide* ([SBAU106](#))
3. *Designing Modular EVMs for Data Acquisition Products* ([SLAA185](#))
4. HPA449 User's Manual (www.softbaugh.com)

Associated Product Data Sheets:

ADS1241 [SBAS173C](#)

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